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EFFECT OF WINTER RATIONS ON PASTURE GAINS OF YEARLING STEERS.[1]

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I. WINTER RATIONS AND THEIR INFLUENCE ON PASTURE GAINS OF YEARLING STEERS.

II. THE COST OF RATIONS FOR WINTERING YEARLING STEERS.

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I. WINTER RATIONS AND THEIR INFLUENCE ON PASTURE GAINS OF YEARLING STEERS.

LOCATION OF THE EXPERIMENTAL WORK.

The work reported in this bulletin is part of a series of beef-cattle experiments that have been in progress since December 22, 1914, conducted on the farm of David Tuckwiller, in Greenbrier County, W. Va., in cooperation between the Bureau of Animal Industry of the United States Department of Agriculture and the West Virginia

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[1] A report of cooperative work by the Bureau of Animal Industry, United States Department of Agriculture, and the West Virginia Agricultural Experiment Station.

[2] The authors acknowledge the services of W. F. Ward, formerly of the Animal Husbandry Division, who assisted in planning this experiment, and of F. W. Farley, J. B. Huyett, and E. A. Tuckwiller, formerly of the same division, who assisted in carrying on the work.

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Agricultural Experiment Station. The purpose is to study beef-production problems in the Appalachian Mountain region. This farm is located in the southeastern part of the State in the blue-grass area. The results of this experiment apply not only to West Virginia but also to the adjacent States having similar conditions, as shown in the outline map (fig. 1). Some of the results and methods may be of such general application as to be utilized to advantage by cattle feeders in other parts of the country.

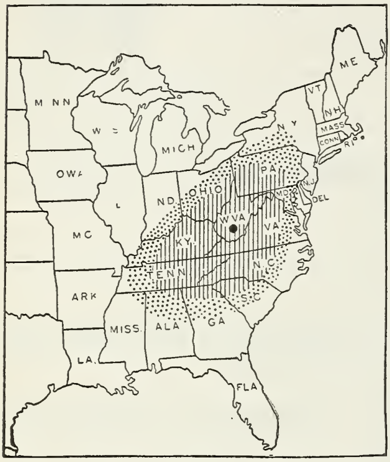

FIG. 1.—Map showing region to which this work applies. The black dot indicates the location of the farm on which the experiment was conducted. The shaded portion represents the area to which the results are applicable, and the dotted portion shows an additional area to which the results apply in part.

THE REGION AND THE PROBLEMS.

The topography in most parts of the region, except in the vicinity of streams, is gently rolling or even mountainous in the higher elevations. The area is generally cleared of forest trees, although vast areas of cut-over or stump land are found. The farms vary in size from less than 100 acres to more than 1,000 acres. The land is especially well adapted for grazing purposes. In most sections there is tillable land for the production of abundant crops for winter feed or other purposes.

It is in this general area that a large percentage of the grass-finished cattle which go annually to eastern markets are produced. The fact that most of the steers produced in this area are finished for market from grass alone attests the value of the pastures, which consist largely of blue grass. The use of grain for finishing cattle is not general, although there are many sections where the practice is followed, particularly in the valleys of the larger streams and on gently rolling areas. By far the larger number of farmers who handle beef cattle grow either stockers and feeders or finish cattle for market from grass alone. It therefore becomes one of the principal beef-production problems in this general area to determine the best and most economical method of wintering the cattle and the one that will enable them to make the best possible use of the pasture the following summer, the time when cheapest gains are made.

It has been a common practice in this area to winter steers on dry feed, such as hay, corn stover, and wheat straw, and on corn silage to a less extent, in a way that causes them to lose materially in weight. They are then pastured the following summer and sold from grass either as stockers or feeders or as finished steers for the market.

There are some who hold the idea that it is profitable to permit this loss of weight, which with older steers often amounts to from 25 to 100 pounds. There are others who believe that cattle wintered on silage, or on a ration of which silage is a part, will not do well on grass the following summer.

OBJECTS AND PLAN OF THE WORK.

The objects of the experiments as a whole had these general problems in view:

1. To ascertain the effect of different wintering rations upon subsequent pasture gains.
2. To determine the most satisfactory and economical method of wintering.
3. To determine the best method and the cost of raising beef cattle in West Virginia.

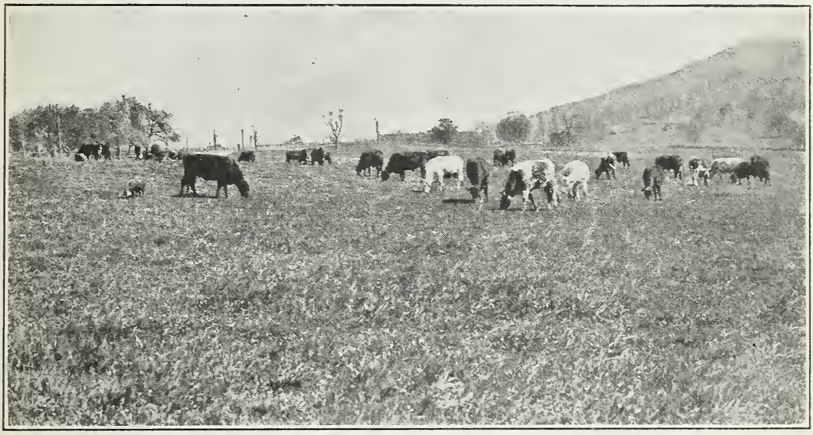

FIG. 2.—The first day on pasture, April 29, 1918, after the cattle had been wintered on a ration of corn silage, cottonseed meal, and wheat straw. (This picture shows the class of cattle, the general appearance of pasture, and the nature of the country.)

Two distinct phases of the problems as outlined in objects 1 and 2 presented themselves for solution: First, the wintering of yearlings that are to be pastured the following summer and sold as stockers or feeders; second, the wintering and subsequent grazing of older steers to be sold from grass when fat. The first, however, is the only one considered here, the second being reserved for further investigation.

The work was carried on for a period of four years, in order to have an average of feedstuffs, cattle, seasons, and other conditions tending to produce variation. The general plan of these experiments, including the rations used for the different lots of steers, is given in Table 1.

TABLE 1.—*Plan of the four years' work.*

Lot No.[1]	Season.	Steers in lot.	Winter feed.[2]	Summer feed.[3]
Lots 1..	1914–15	10	Corn silage, mixed hay, and wheat straw	Pasture.
	1915–16	10	.....do	Do.
	1916–17	10	.....do	Do.
Lots 2..	1914–15	10	Corn silage, wheat straw, and cottonseed meal	Do.
	1915–16	10	.....do	Do.
	1916–17	10	.....do	Do.
	1917–18	10	.....do	Do.
Lots 3..	1914–15	10	Mixed hay and wheat straw	Do.
	1915–16	10	.....do	Do.
	1916–17	10	.....do	Do.
	1917–18	10	.....do	Do.
Lot 4...	1917–18	10	Corn silage and soy-bean hay	Do.
Lot 5...	1917–18	10	Corn silage, rye hay, and cottonseed meal	Do.

[1] New lots of steers were used each year, totaling as follows: 1914, 30 steers; 1915, 30 steers; 1916, 30 steers; 1917, 40 steers.

[2] From time cattle were taken off pasture in December until turned on pasture, about May 1.

[3] From time cattle went on grass in spring until sold. Each summer all the steers were turned into the same pasture and had no feed except the grass.

KIND OF STEERS USED.

The steers used in this work were of grade Shorthorn, Hereford, and Aberdeen-Angus breeding. They were raised in southern West Virginia and were a good, uniform lot of cattle in age, weight, quality, and condition. They averaged from 650 to 675 pounds in weight at the beginning of the winter period and were 1 year old the previous spring.

FEEDS USED.

Samples of each of the feeds used were taken at different times throughout the four winter-feeding periods and sent to the Department of Chemistry, West Virginia Experiment Station, Morgantown, W. Va., to be analyzed. The averages of these analyses are given in Table 2. Average analyses for these feeds as computed by the U. S. Department of Agriculture are shown in Table 2 in heavy type.

TABLE 2.—*Composition of feeds used.*

Feeds.	Moisture.	Protein.	Carbohydrates, including fiber.	Fat.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Corn silage	75.0	1.9	21.5	0.5	1.1
	70.9	**2.4**	**24.4**	**0.9**	**1.4**
Mixed hay	8.3	6.6	79.5	1.9	3.7
Wheat straw	8.4	2.9	84.1	1.4	3.2
	9.6	**3.4**	**81.5**	**1.3**	**4.2**
Rye hay	8.4	5.8	79.8	1.2	4.8
	6.4	**5.9**	**81.0**	**2.0**	**4.7**
Soy-bean hay	9.0	10.0	68.9	3.0	9.1
	8.4	**15.8**	**63.1**	**3.8**	**8.9**
Cottonseed meal	7.7	37.6	40.3	8.3	6.1
	7.3	**36.8**	**43.6**	**6.6**	**5.8**

From the analyses it is evident that the feeds used, with the exception of cottonseed meal, were somewhat below the average in quality. The cottonseed meal used was of 41 per cent protein the first year and of 36 per cent protein the last three years. The silage was made from a mixture of dent and silage corn.

A three-year rotation of crops, consisting of corn, wheat, and hay, is practiced pretty generally in the section under discussion. Timothy is sown with the wheat in the fall, and clover is sown on the same field in the spring. This provides in the year following the wheat crop a mixed hay of timothy and clover. The mixed hay used in this work was obtained in this manner.

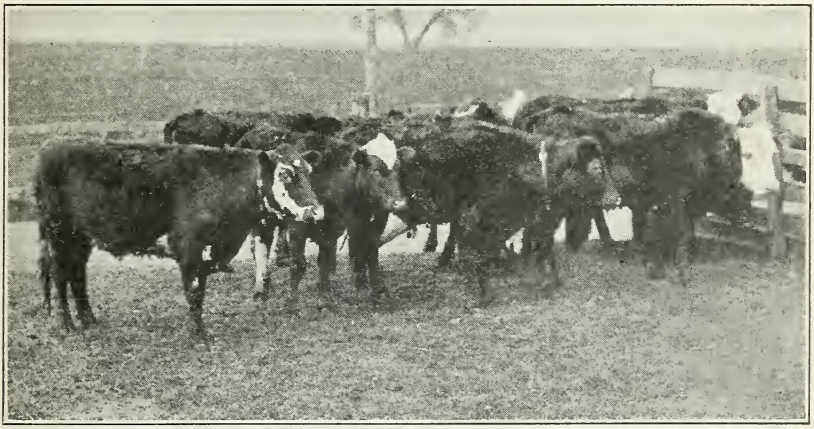

FIG. 3.—Steers in Lot 2 at end of winter feeding, 1917-18.

In making soy-bean hay the ground is prepared about the same as it would be for corn. The beans are drilled broadcast, using 1½ bushels per acre. They are usually sown the last of May or the first of June, after all danger of heavy frost is past. When the beans begin to form in the pods, about the first of September, the time varying with the variety of beans and the kind of season, the crop is cut and cured for hay.

In making rye hay the seed is sown in the fall, as it would be for raising grain, except that more seed per acre is used. In the spring, just before the rye blooms, it is cut and cured.

The composition and nutritive ratio of the rations fed are given in Table 3.

TABLE 3.—*Composition and nutritive ratio of rations used.*

Lot No.	Ration.	Average quantity per steer.	Composition.				Nutritive ratio.
			Dry matter.	Protein.	Carbohydrates.	Fat.	
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
1	Corn silage	20.0	5.26	0.220	3.000	0.140	
	Mixed hay	5.0	4.39	.200	1.985	.055	
	Wheat straw	2.54	2.33	.018	.891	.013	1:14.5
		....	11.98	.438	5.876	.208	
2	Corn silage	23.1	6.08	.254	3.465	.162	
	Wheat straw	4.9	4.49	.034	1.720	.025	
	Cottonseed meal	1.0	.93	.334	.243	.079	1:9.7
		....	11.50	.622	5.428	.266	
3	Mixed hay	11.9	10.45	.476	4.724	.131	
	Wheat straw	4.07	3.73	.028	1.429	.020	1:12.9
		....	14.18	.504	6.153	.151	
4	Corn silage	20.0	5.26	.220	3.000	.140	
	Soy-bean hay	6.0	5.48	.702	2.352	.072	1:6.3
		....	10.74	.922	5.352	.212	
5	Corn silage	20.0	5.26	.220	3.000	.140	
	Rye hay	6.0	5.51	.204	2.760	.066	
	Cottonseed meal	.5	.46	.167	.122	.039	1:10.9
		....	11.23	.591	5.882	.245	

Table 3 indicates that the quantity of dry matter fed was practically the same in all lots, the chief difference in the ration being in the proportion of protein to carbohydrates.

CHARACTER OF PASTURE.

Each year the steers were turned on a rather rough pasture of about 160 acres, one-fourth of which is in woodland. The pasture is situated in a valley between two small mountains, and a small stream which flows through it provides an abundance of fresh water at all times throughout the summer.

The soil is of limestone formation, and a good growth of blue grass with much white clover is found on all parts of the pasture not in timber. Under normal climatic conditions there is rainfall enough to keep the grass growing throughout the season. The latter part of the summer of 1917 was rather dry, however, and during August of that year the steers made but small gains.

METHOD OF FEEDING AND HANDLING THE STEERS.

In the fall before starting the steers on the winter feed they were divided into lots of 10 each. In this division care was taken to have the lots as nearly the same as possible in regard to quality breeding, size, and condition. These different lots were given the same amount of space in open sheds with small outside lots about 30 by 60 feet in size. Water was supplied in these lots at all times, and salt was constantly available. The cattle were fed twice a day.

The feed, both concentrates and roughages, was weighed each time and accurate records of it made. The steers were weighed at the beginning and at the end of the feeding period, the weights being taken 3 days in succession and an average taken for their initial and final weights. They were weighed also every 28 days. For identification, neck straps with numbers on them were used and individual weights taken in the morning after feeding.

QUANTITY OF FEED CONSUMED.

In considering the quantity of feed consumed it should be kept in mind that these cattle were getting only maintenance rations, but enough to keep them in good, strong, thrifty condition. Table 4 shows the total quantity of different feeds eaten in the various lots and the average daily ration per steer in each lot during each of the four winters. It also gives the averages for each ration for all the years in which it was fed.

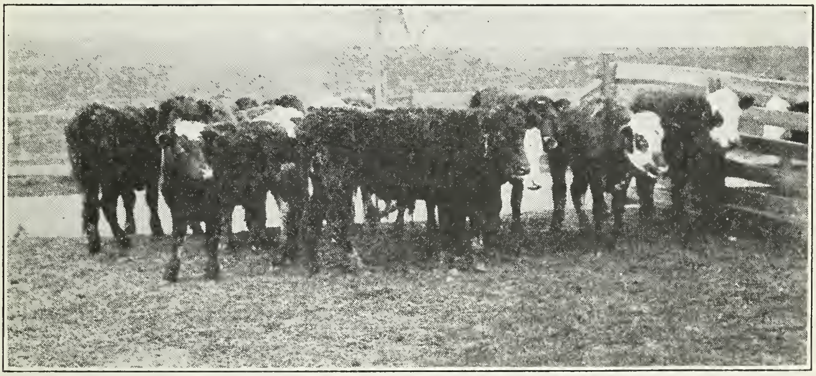

FIG. 4.—Steers in Lot 3 at end of winter feeding, 1917–18.

TABLE 4.—*Average total and daily rations during four winters.*

Lot No. and ration.	Total feed per steer.					Daily feed per steer.				
	1914–15 (128 days).	1915–16 (122 days).	1916–17 (134 days).	1917–18 (133 days).	Average.	1914–15 (128 days).	1915–16 (122 days).	1916–17 (134 days).	1917–18 (133 days).	Average.
Lot 1:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Corn silage	2,111.5	2,440	3,015	....	2,522.2	17.0	20.0	22.5	....	19.8
Mixed hay	653.0	610	670	....	644.3	5.0	5.0	5.0	....	5.0
Wheat straw	429.0	265	271	....	321.7	3.4	2.2	2.0	....	2.5
Lot 2:										
Corn silage	3,105.0	3,050	3,015	2,660	2,957.5	25.0	25.0	22.5	20.0	22.9
Wheat straw	561.0	610	628	738	634.2	4.3	5.0	4.7	5.5	4.9
Cottonseed meal	127.5	122	134	135	129.6	1.0	1.0	1.0	1.0	1.0
Lot 3:										
Mixed hay	1,278.5	1,464	1,622	1,782.2	1,536.7	10.0	12.0	12.1	13.4	11.9
Wheat straw	602.5	530	611	359.1	525.6	4.7	4.3	4.6	2.7	4.1
Lot 4:										
Corn silage	....	....	....	2,660.0	....	....	....	....	20.0	....
Soy-bean hay	....	....	....	798.0	....	....	....	....	6.0	....
Lot 5:										
Corn silage	....	....	....	2,660.0	....	....	....	....	20.0	....
Rye hay	....	....	....	798.0	....	....	....	....	6.0	....
Cottonseed meal	....	....	....	66.5	....	....	....	....	0.5	....

GAINS AND LOSSES DURING WINTER.

The gains and losses in weight during each of the four winters are shown in Table 5.

TABLE 5.—*Total and daily gains and losses during four winters.*

Lot No.	Ration.	Year.	Number of steers.	Days fed.	Average initial weight per steer.	Average weight per steer at end of winter period.	Total gain (+) or loss (−) per steer.	Daily gain (+) or loss (−) per steer.
					Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
1	Corn silage, mixed hay, and straw	1914–15	10	128	622	599	− 23	− 0.18
		1915–16	10	122	678	678	....	....
		1916–17	10	134	690	709	+ 19	+ .14
	Average	....	10	128	663	662	− 1	− .01
2	Corn silage, wheat straw, and cottonseed meal	1914–15	10	128	618	692	+ 74	+ .58
		1915–16	10	122	678	758	+ 80	+ .66
		1916–17	10	134	690	742	+ 52	+ .39
		1917–18	10	133	671	711	+ 40	+ .30
	Average	....	10	129	664	726	+ 62	+ .48
3	Mixed hay and wheat straw	1914–15	10	128	623	577	− 46	− .36
		1915–16	10	122	678	671	− 7	− .06
		1916–17	10	134	689	659	− 30	− .22
		1917–18	10	133	671	615	− 56	− .42
	Average	....	10	129	665	630	− 35	− .46
4	Corn silage and soy-bean hay	1917–18	10	133	671	698	+ 27	+ .20
5	Corn silage, rye hay, and cottonseed meal	1917–18	10	133	671	682	+ 11	+ .08

Table 5 shows that there was a marked similarity between the results of each year's feeding in the case of the rations fed to Lots 1, 2, and 3. Lot 1, the silage, mixed-hay, and straw-fed steers, lost slightly the first year, maintained their weight the second year, and gained nearly as much the third year as they had lost the first. Referring to the quantities of feed fed each year, as given in Table 4, it seemed evident that this was due to the increased rations given during the second and third years. Lot 2, fed silage, straw and cottonseed meal, gained considerably each year, the average gain for the four years being 62 pounds per steer. The least gain was made the fourth year, when the smallest quantity of feed per day was given. Lot 3, the mixed-hay and straw-fed steers, lost in weight each year, the average loss for the four years being 34 pounds per head. As the rations of Lot 4, corn silage, and soy-bean hay, and Lot 5, corn silage, rye hay, and cottonseed meal, were fed during only one winter, that of 1917–18, the results can not be considered so conclusive as those obtained in feeding the other rations. However, the gains made, 27 and 11 pounds, respectively, show them to be satisfactory from the standpoint of maintenance.

GAINS DURING SUMMER.

In the spring of each year, as soon as the grass was good enough, which was usually about May 1, the steers from all the lots were turned into the same pasture on grass, with no additional feed. Weights were taken every 28 days, just as during the winter. Thus the effect of the different rations upon the summer grazing of the different lots could be studied.

Table 6 shows the weights at the beginning and at the end of the grazing period and the total and average gains per steer for the summer period.

FIG. 5.—Steers in Lot 4 at end of winter feeding, 1917–18.

TABLE 6.—*Total and daily gains during four summers on pasture alone.*

Lot No.	Ration of previous winter.	Year.	Number of steers.	Days on pasture.	Average weight per steer at beginning of grazing period.	Average final weight per steer.	Total gain per steer for summer.	Average daily gain per steer.
					Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
1	Corn silage, mixed hay, and wheat straw	1914–15	10	168	599	935	336	2.0
		1915–16	10	167	678	1,022	344	2.1
		1916–17	10	157	709	979	270	1.7
	Average		10	164	662	979	317	1.9
2	Corn silage, wheat straw, and cottonseed meal	1914–15	10	168	692	947	255	1.5
		1915–16	10	167	758	1,036	278	1.7
		1916–17	10	157	742	1,000	258	1.6
		1917–18	10	140	711	969	258	1.8
	Average		10	158	726	988	262	1.6
3	Mixed hay and wheat straw	1914–15	10	168	577	892	315	1.9
		1915–16	10	167	671	981	310	1.9
		1916–17	10	157	659	965	306	1.9
		1917–18	10	140	615	920	305	2.2
	Average		10	158	630	939	309	2.0
4	Corn silage and soy-bean hay	1917–18	10	140	698	938	240	1.7
5	Corn silage, rye hay, and cottonseed meal	1917–18	10	140	682	963	281	2.0

GAINS AND LOSSES, WINTER AND SUMMER.

The gains and losses in weight in both winter and summer are summarized in Table 7, and averages are shown for lots fed on the same rations in different years.

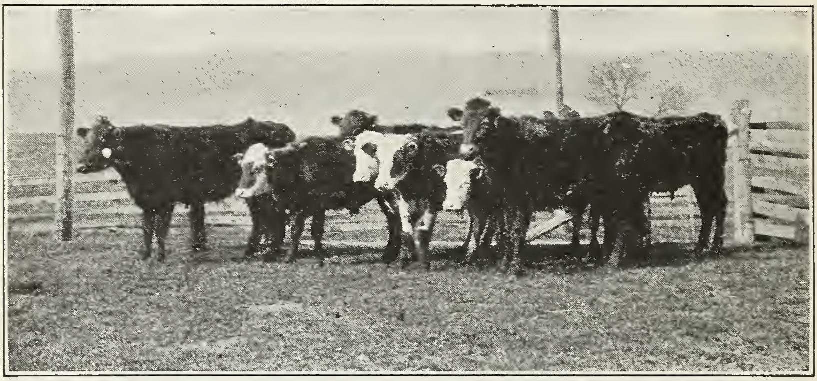

FIG. 6.—Steers in Lot 5 at end of winter feeding, 1917–18.

TABLE 7.—*Summary of gains and losses in weight per steer, winter and summer.*

Lot No.	Ration.	Year.	Gain (+) or loss (−) in weight per steer in winter.	Gain in weight per steer in summer.	Total gain in weight per steer, winter and summer.
			Pounds.	*Pounds.*	*Ponnds.*
1	Corn silage, mixed hay, and wheat straw	1914–15	−23	336	313
		1915–16	+00	344	344
		1916–17	+19	270	289
	Average		− 1	317	316
2	Corn silage, wheat straw, and cottonseed meal	1914–15	+74	255	328
		1915–16	+80	278	358
		1916–17	+52	258	380
		1917–18	+40	258	298
	Average		+62	262	324
3	Mixed hay and wheat straw	1914–15	−46	315	269
		1915–16	− 7	310	303
		1916–17	−30	306	276
		1917–18	−56	305	249
	Average		−35	309	274
4	Corn silage and soy-bean hay	1917–18	+27	240	267
5	Corn silage, rye hay, and cottonseed meal	1917–18	+11	281	292

GRAPHIC PRESENTATION OF GAINS AND LOSSES.

The comparative rapidity and extent of gains and losses can be shown more clearly by the use of a chart than in any other way. Accordingly a chart is presented herewith as figure 7, which shows the average changes in weight of the steers of the three lots.

Horizontal distance on the chart indicates the number of days that the steers were fed during the winters and pastured during the summers. The average length of the total period for the 4 years was 288 days, of which 130 days were in the winter or feeding period and the remaining 158 in the summer or grass period. The heavy, black vertical line near the center of the chart marks the dividing line between the winter and summer periods.

Vertical distance on the chart represents changes in live weight of the steers. The weights corresponding to each of the horizontal lines are given along the left side of the chart.

Some rather striking facts as to the way steers on different rations vary in weight from period to period during the winter are brought out. It will be noted that in Lots 1 and 3 there was an actual loss in weight each year during the first period of the winter. By the end of the second period this tendency to lose in weight had been overcome, and in most of the trials a slight gain was made during this period. While the average of Lot 2 showed a small gain during the first period, it is evident that the rapidity of gain was greatly increased during the second period.

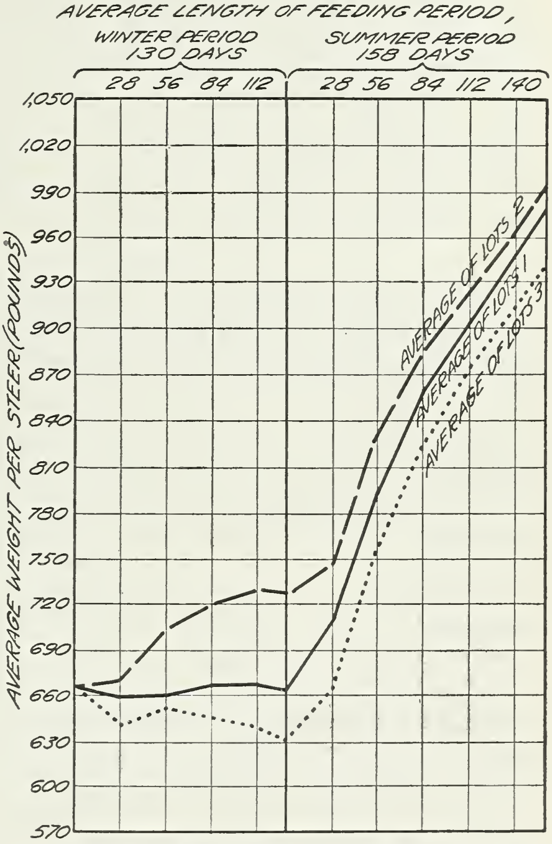

FIG. 7.—Diagram showing average variations in weights of 3 lots of steers during summer and winter feeding periods.

With one or two exceptions there was a marked loss in weight of steers in all lots during the last 18 days of the winter period. This falling off in weight can, no doubt, be attributed to the fact that the coming of the pasture season caused the steers to eat less dry feed and possibly to make less efficient use of what they did eat. Cattle fed on dry feed during the winter become restless with the appearance of grass and lose their appetites for the dry and less appetizing feeds which they have been receiving.

There are some very noticeable differences in the gains made by the different lots during the first 28 days of the pasture season. With one exception all lots in each trial took on weight. The steers of Lot 3 during this first period in the spring of 1917 actually lost 2 pounds per head while on grass. There is no apparent explanation for this loss, in view of the fact that both Lots 1 and 2 made gains during this same month, and after all the steers were in the same pasture and received the same treatment.

As would be expected, the cattle which had been fed on a ration that caused them to lose weight during the winter and the steers which had barely maintained their weight during the winter made greater gains during the first month on pasture than the steers which had been fed on a ration which caused a gain throughout the winter.

The greatest gains from pasture were made by the steers of Lot 1, although the difference between this lot and Lot 3 is so slight as to be almost negligible. While the summer gains of the steers of Lot 2, fed silage, cottonseed meal, and straw, were not so large as those of the other two lots, the total of both winter and summer gains shows an increase of 50 pounds over the gains made by the steers fed mixed hay and wheat straw and 8 pounds over those fed corn silage, mixed hay, and wheat straw.

SUMMARY.

1. When good yearling steers averaging 664 pounds at the beginning of the winter feeding period are fed the following amounts of feed per steer daily the gains or losses stated may be expected during the winter.

	Daily feed (pounds).	Gain (+) or loss (−) (pounds).
Corn silage	19.8	−1
Mixed hay	5.0	....
Wheat straw	2.5	....
Corn silage	23.1	+62
Wheat straw	4.9	....
Cottonseed meal	1.0	....
Mixed hay	11.9	−35
Wheat straw	4.1	....

2. Whereas the two lots of silage-fed steers (Lots 1 and 2) received practically equal quantities of digestible nutrients during the winter feeding period, the steers fed cottonseed meal (Lot 2) and, consequently, more protein, gained in weight (62 pounds per steer) while the steers receiving mixed hay barely maintained their weight.

3. The silage-fed steers in Lots 1 and 2 were carried through the winter in better condition than the steers of Lot 3, fed wholly on dry roughage.

4. Steers wintered on dry roughage alone (Lot 3) which lost most weight during the winter (35 pounds) and those fed a maintenance ration only of which corn silage was a part (Lot 1) made greater gains during the first month on grass than those steers (Lot 2) which had also received a silage ration and made 62 pounds gain during the winter. There was 97 pounds difference between the average weight of steers in Lots 2 and 3 and 63 pounds between Lots 1 and 2 when turned on to grass at the end of the winter feeding period. It was

largely due to this difference in condition that the steers in Lots 1 and 3 were able to make greater gains during the first 28 days on grass.

5. There was a very slight tendency among the steers fed on dry roughage alone during the previous winter (Lot 3) to make less gain during the last two months of the pasture season than the steers which had received silage in the winter ration (Lots 1 and 2).

6. The silage-fed steers made greater gains for the entire year, including both winter and summer, than the steers fed dry roughage alone.

II. THE COST OF RATIONS FOR WINTERING YEARLING STEERS.

Shall I purchase in the fall steers that are to be fattened from grass the next summer and carry them through the winter largely on roughage, or shall I purchase them in the spring after some one else had wintered them? This is a question which the thoughtful cattle grazer in the good pasture areas is likely to ask himself and which is of considerable importance to answer correctly. No matter what the answer may be on any particular farm or in any particular section of country, the fact remains that cattle are higher in price and are worth more in the spring, when the grass is ready for grazing, than they were at the close of the pasture period the preceding fall. This increased value in the spring is usually sufficient to pay for the cost of wintering. Grazers are in a better position in the spring than in the previous fall to know how many cattle they can handle on grass.

In the following discussion of this question it is necessary to fix the prices for feeds on the farm. It is felt, however, that this is the most questionable and unsatisfactory part of such experimental work, and is especially true of the last few years, during which unusual fluctuations occurred in feed prices.

PRICES OF FEEDS USED.

During the four years that this experiment was in progress the farm price of corn in West Virginia on December 1 increased from 83 cents to $1.70 a bushel, and that of hay from $17.20 to $21.10 a ton. Thus the cost of wintering a steer in 1917–18 was nearly double the cost of keeping him through the winter of 1914–15. For this reason, and also for simplicity in making the various calculations, the following feed prices are used:

	Per ton.		Per ton.
Corn silage	$6	Soy-bean hay	$17
Mixed hay	18	Wheat straw	7
Rye hay	18	Cottonseed meal	50

The foregoing prices are based upon the average farm price of corn and hay on December 1, as given in the Yearbook of the United States Department of Agriculture for the States of West Virginia, Virginia, Maryland, Pennsylvania, Ohio, Kentucky, Tennessee, and North Carolina.

An attempt is made to show the comparative cost of the different rations for the benefit of those who desire information on this phase of the subject. If the prices of feeds in any locality are different from the prices used in these calculations, it is suggested that they be substituted and the following calculations used as a guide, using, as the basis of calculation, the total amounts of the different feeds consumed per steer, as shown in the first section of Table 4.

COST PER POUND OF GAIN.

The cost of feeding a steer during the winter, plus the cost of pasture the following summer, is the total cost of feeding the steer for the year. By dividing this amount by the increase in weight of the steer the cost of producing a pound of gain is obtained. It is considered that the cost of labor and other expenses are balanced by the value of the manure produced. In Table 8 it will be noted that the winter cost constitutes approximately two-thirds of the total cost for the year. Practically all the gain, however, is made during the summer or pasture season; hence the cost of wintering and the influence of the winter rations upon the utilization of pasture the following summer become the chief factors governing the cost of a pound of gain. The cost of producing a pound of gain is the main factor in determining whether a steer is being produced at a profit or a loss. A summary of gains and costs is given in Table 8.

TABLE 8.—*Summary of gains and costs.*

Lot No.	Ration.	Year.	Gain (+) or loss (−) per steer.	Total gain winter and summer per steer.	Cost per steer, winter.	Cost per steer, summer.[1]	Total cost of feed and pasture per year per steer.	Cost per pound of yearly gain.
			Pounds.	*Pounds.*				
1	Corn silage, mixed hay, and wheat straw.	1914–15	−23	313	$13.71	$8.40	$22.11	$0.070
		1915–16	....	344	13.74	8.35	22.09	.064
		1916–17	19	289	16.03	7.85	23.88	.083
	Average..........	....	− 1	316	14.49	8.20	22.69	.072
2	Corn silage, wheat straw, and cottonseed meal.	1914–15	+74	328	14.47	8.40	22.87	.070
		1915–16	+80	358	14.34	8.35	22.69	.063
		1916–17	+52	310	14.60	7.85	22.45	.072
		1917–18	+40	298	13.88	7.00	20.88	.070
	Average..........	....	+62	324	14.32	7.90	22.22	.069
3	Mixed hay and wheat straw.	1914–15	−46	269	13.62	8.40	22.02	.082
		1915–16	− 7	303	15.03	8.35	23.38	.077
		1916–17	−30	276	16.74	7.85	24.59	.089
		1917–18	−56	249	17.30	7.00	24.30	.097
	Average..........	....	−35	274	15.67	7.90	23.57	.086
4	Corn silage and soy-bean hay.	1917–18	+27	267	14.76	7.00	21.76	.081
5	Corn silage, rye hay, and cottonseed meal.	1917–18	+11	292	16.82	7.00	23.82	.081

[1] The cost of summer feed is calculated at the same rate for each lot each year, charging the pasture at 5 cents a day as follows:

168 days, 1915....................................	$8.40
167 days, 1916....................................	8.35
157 days, 1917....................................	7.85
140 days, 1918....................................	7.00

The steers of Lot 2, which were fed corn silage, wheat straw, and cottonseed meal, made the greatest gains during the year at least cost for feed. Hence the cost of a pound of gain was lowest for these lots, the average for four years being 6.9 cents. Lot 1, fed corn silage, mixed hay, and wheat straw, put on gains at an average cost of 7.2 cents a pound. Steers fed mixed hay and wheat straw, which is by far the most commonly used ration in the section under discussion, made smaller yearly gains at greater cost than did the steers of the two lots mentioned. It cost 8.6 cents to put on a pound of gain when the wintering ration consisted of mixed hay and wheat straw.

The cost of producing a pound of gain was comparatively high in Lots 4 and 5, being 8.1 cents a pound for each lot. The rations used, while an improvement over the commonly used combinations of mixed hay and wheat straw, were too costly, when resulting gains are considered, to be recommended generally.

VALUE OF SILAGE IN THE RATIONS.

In Table 9 the increased gain per steer to be obtained by the use of corn silage in the rations and the saving thereby are shown. Since most of the cattle wintered in West Virginia and neighboring States are carried through on dry feed, the steers fed mixed hay and wheat straw were used as a basis from which to make comparisons, and those feeds were considered a check ration. For the sake of a comparison the increased gain is given, arbitrarily, a value of 10 cents a pound and added to the difference in the cost of the rations to obtain the last column of Table 9.

TABLE 9.—*Summary showing value of silage rations as compared with mixed hay and straw (check ration).*

Lot No.	Winter ration.	Years fed.	Average yearly gain per steer.	Increased gain per steer over steers fed check ration.	Average yearly cost of feed and pasture per steer.	Decrease in cost of ration as compared with check ration.	Increased value of ration per steer compared with check ration.
			Pounds.	*Pounds.*			
3	Mixed hay and wheat straw (check ration)	4	274	....	$23.57	....	....
1	Corn silage, mixed hay, and wheat straw	3	316	42	22.69	$0.88	$5.08
2	Corn silage, wheat straw, and cottonseed meal	4	324	50	22.22	1.35	6.35
4	Corn silage and soy-bean hay	1	267	7	21.76	1.81	2.51
5	Corn silage, rye hay, and cottonseed meal	1	292	18	23.82	[1] −0.25	1.55

[1] The ration of lot 5 cost more than the check ration of mixed hay and wheat straw.

Table 9 shows that the addition of corn silage to the dry-feed ration resulted in an increase of 42 pounds in the yearly gain of each steer in Lot 1 as compared with the check ration, and the substitution of cottonseed meal and corn silage in place of mixed hay produced an increase of 50 pounds of gain per steer in Lot 2. With feeds at prices as charged during the first three years, however, the dry-feed ration was the most costly. It cost 88 cents less to feed a steer on corn silage, mixed hay, and wheat straw than on mixed hay and straw alone. The addition of cottonseed meal and the elimination of the hay decreased the cost $1.35. Since the average initial weights of the lots were practically the same for each trial, and since all lots were summered on the same pasture, the difference in final weight can be attributed to the different rations fed during the winter.

Table 9 also shows that when the gain put on cattle on grass is worth 10 cents a pound, the profit per steer may be increased from $1.55 to $6.35 by the use of corn silage in the ration. This increase is largely attributed to the increased gains of the silage-fed cattle, although the cost or value of the feeds is an important factor.

GENERAL SUMMARY OF COSTS AND GAINS.

A general summary of costs and gains is given in Table 10.

TABLE 10.—*General summary of costs and gains.*

Items.	Lots 1, (corn silage, mixed hay and wheat straw).	Lots 2, (corn silage, wheat straw, and cottonseed meal).	Lots 3, (mixed hay and wheat straw).	Lots 4, corn silage and soybean hay).	Lots 5, (corn silage, rye hay, and cottonseeed meal).
Average cost of wintering	$14.49	$14.32	$15.67	$14.76	$16.82
Average length of winter periods ... days	128	129¼	129¼	133	133
Cost of feed per day, winter	$0.116	$0.111	$0.121	$0.111	$0.127
Average cost of summer feed	$8.20	$7.90	$7.90	$7.00	$7.00
Average length of summer periods ... days	164	158	158	140	140
Cost per day, summer	$0.05	$0.05	$0.05	$0.05	$0.05
Average of total costs per year	$22.69	$22.22	$2..57	$21.76	$23.82
Average gain or loss per steer, winter ... pounds	−1	+62	−35	+27	+11
Average gain per steer, summer ... do	317	262	309	240	281
Average total gain per steer ... do	316	324	274	267	292
Cost per pound yearly gâin	$0.072	$0.069	$0.086	$0.081	$0.081

SUMMARY.

1. Corn silage, wheat straw, and cottonseed meal (fed to Lots 2) was the cheapest ration used and at the same time the best, making the greatest increase (62 pounds) in weight of the steers. It is seldom that one gets the best for the least money.

2. Silage added to a ration for wintering steers makes it more economical than dry roughage alone, considering the gains made both during the winter and in the summer following the winter feeding period.

3. The average gain per head for the year for all the steers fed corn silage was 39 pounds greater than that for steers wintered on dry roughage alone, while the average cost per head was $1.07 less for the silage-wintered steers. With but few exceptions, a farmer or stockman (in the section considered) who has a sufficient number of mature cattle or their equivalent is justified in building a silo.

4. After the farmer or stockman has his silo he may advantageously buy a protein supplement. The quantity of cottonseed meal or other protein-rich feed depends upon the kind of roughage used with the silage. If a legume hay is used, the cottonseed meal or other protein concentrate may be eliminated entirely or at least reduced very materially in quantity.

5. As a general rule, where the farmer has silage and a roughage in the form of straw or various kinds of hay and stover, it would seem advisable to feed his yearling cattle (should he wish to winter them and sell them from grass the next summer) a ration of silage, a little cottonseed meal—not more than 1 to 1½ pounds—or other such feed, and the roughage that he has available.

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